REMARKS:

1) In item 10) of the Office Action Summary, the Examiner has indicted the acceptance of the original drawings filed on August 31, 2001. However, a revised Replacement Sheet of drawings was filed on February 23, 2005, to replace the original drawings. Please indicate that the revised Replacement Sheet of drawings filed on February 23, 2005 has been accepted.

2) The claims have been amended as follows.

In independent claims 1 and 16, it has been made clear that the additional information conveyed by the modulation indices is information in addition to and distinct from the data conveyed by the information symbols. This is a further clarification of the prior amendment relating to the "additional information" that is supported in the original disclosure (e.g. page 3 lines 11 to 22, page 4 lines 1 to 12, etc.) and is a generalization of the example given in claim 23. Thus, the present clarifying amendment does not introduce any new matter.

Claim 7 has been amended from independent form to dependent form, so that claim 7 now depends from claim 1 as before.

Claim 29 has been amended from independent form to dependent form, so that claim 29 now depends from claim 16 as before.

Entry and consideration of the claim amendments are respectfully requested.

3) Referring to the bottom of page 9 of the Office Action, the allowance of claim 13 is appreciated. Claim 13 has been maintained without further amendment, and should thus still stand allowed.

4) Referring to the bottom of page 2 of the Office Action, the Examiner's reply to applicant's prior arguments has been taken into account in the present amendment of claims 1 and 16. Namely, the present clarifying amendment avoids and excludes an unintended interpretation of "additional information" on which the Examiner's position is based. Particularly, claims 1 and 16 now recite that the "additional information" is in addition to and also distinct from the data conveyed by the information symbols. As will be discussed below, the prior art would not have suggested a method as presently claimed, in which the modulation indices convey additional information in addition to **and distinct from** the data that is conveyed by the information symbols.

5) As many of the rejections in the present Office Action repeat rejections using the same references from the prior Office Action, applicant respectfully incorporates herein and reasserts the arguments set forth in the Response of September 28, 2005. Additionally, please consider the following further distinguishing remarks.

6) Referring to pages 3 to 4 of the Office Action, the rejection of claims 1, 3, 5, 16 to 19, 21, 22, 27, 28 and 32 as obvious over

WO 99/33237 (Piirainen et al.) in view of IEEE Journal on Selected Areas in Communications, Vol. 7 No. 9 (Hwang et al.) is respectfully traversed.

7) As mentioned above, independent claims 1 and 16 now make clear that the additional information conveyed by the modulation indices is in addition to **and distinct from** the data conveyed by the information symbols.

This allows the inventive method to transmit truly **additional** and separate useful information in the modulated signal, and thereby increase the total information content or information transmission rate of the transmitted signal. For example, the information symbols encode data such as numerical values of a measured temperature, pressure, speed, or the like. Furthermore, the modulation index itself conveys additional information distinct from the encoded numerical data, for example identifying the type of data, such as the fact that the numerical data represents a temperature value, or a pressure value, or a speed value, or the like. Therefore, in the inventive method, it is not necessary to separately encode this additional information with additional information symbols. As a result, for a given number of information symbols or total transmission period, the inventive method can transmit more information (for example both a set of numerical values as well as the additional information designating these numerical values as temperature values).

Claims 1 and 16 further recite that the receiver (e.g. the second transceiver) evaluates the modulated signal **to obtain** the

data **and the additional information**. It is clear that the receiver is obtaining both the data and the additional information from the modulated signal by evaluating the modulated signal. Thus, both the data and the additional information represent useful data or useful information that was previously "unknown" to the receiver, which then obtains the data and the additional information by evaluating the modulated signal.

8) The prior art does not disclose and would not have suggested the above features of the inventive method.

As acknowledged by the Examiner, Piirainen et al. do not teach features of a method involving assigning a different modulation index to each information symbol, whereby the information symbols convey data and the modulation indices convey additional information in addition to the data. In this regard, the Examiner has referred to Hwang et al.

Hwang et al. disclose both a conventional MHPM modulation scheme, and a new MHPM modulation scheme. Both of these schemes involve varying the modulation index of successive information or data symbols in order to increase the accuracy (reduce the error rate) of the detection of the transmitted data symbols in a receiver (see abstract; page 1451, right column, lines 3 to 21; page 1453, left column, lines 5 to 20; page 1455, right column, last paragraph; page 1460, right column, lines 1 to 7). Particularly, the different modulation indexes applied to successive data symbols act as a "check" or a degree of redundancy for confirming the accuracy of the detection of the respective associated data symbols as received in the receiver.

For this purpose of reducing the error rate (i.e. increasing the accuracy) of the detection of the normal data conveyed by the data symbols, it is necessary that the expected modulation indexes must already previously be known in the receiver.

In this regard, the conventional MHPM scheme uses a cyclically varying pattern or sequence of modulation indexes assigned to successive data symbols (page 1450, left column, lines 20 to 25; page 1450, right column, lines 9 to 30; page 1451, left column, paragraph between equations (2) and (3); etc.). Such a fixed cyclic variation of the modulation index cannot provide any additional data. Instead, the pattern of the fixed cyclic variation of the modulation index must be know previously in the receiver, so that the proper modulation index is used for decoding and evaluating each respective data symbol in the receiver station in a manner synchronized with the transmitter station (see page 1450, left column, line 20 to right column, line 30).

In the new MHPM scheme according to Hwang et al., the varying modulation index assigned to successive information or data symbols depends on the time index i and also on the respective data value of the respective associated data symbol. Namely, for a data symbol that can have a bipolar data value of either +1 or −1, a modulation index h_{+i} or h_{-i} will be assigned to this data symbol respectively. Namely, at time i, the data symbol having value +1 will be assigned the modulation index h_{+i} or the particular modulation index ha in an example, while the data symbol having value −1 will be assigned the modulation index h_{-i} or hb in the example (page 1451, right column, from equation

(5) to bottom of page; page 1452, left column, equation (6) to bottom of page; etc.). In any event, the modulation index assigned to a respective data symbol **always corresponds to the data value** of the respective data symbol (page 1450, right column, lines 26 to 31; page 1451 right column, lines 40 to 41 etc.).

Regarding the method of Hwang et al., the Examiner has asserted that "*the modulation indices convey additional information in addition to the data (i.e. represents the data type that is bipolar and it is either +1 or -1)*". It is recognized that the modulation index in the new MHPM concept of Hwang et al. conveys information, namely the data value that is also conveyed by the respective data symbol to which the modulation index is assigned. At signaling interval or time i, the modulation index h_{+i} (e.g. ha) indicates or conveys the data value +1, while similarly the modulation index h_{-i} (e.g. hb) indicates the data value -1. That is **NOT additional information distinct** from the data value, but rather is **exactly the SAME information** (data value) that is conveyed by the data symbol at time i. In effect, the method according to Hwang et al. conveys the same data **twice**, namely once by the data symbol having value +1 and once by the associated modulation index h_{+i} (ha). This redundancy allows for error checking to thereby improve the accuracy (reduce the error rate) in the detection and evaluation of the data symbol having data value +1, for example.

As such, the transmission method according to Hwang et al. cannot transmit **additional** data that is **in addition to and distinct from** the data value conveyed by the data symbol, because

Hwang et al. absolutely require the modulation index to correspond to the data value of the data symbol to achieve the intended purpose of reducing the error rate in the reception and evaluation of the modulated signal.

While the Examiner has asserted that the modulation index conveys "additional information", after the present further clarifying amendment of present independent claims 1 and 16, it should be especially clear that the information conveyed by the modulation indices according to Hwang et al. is certainly **not** in addition to **and distinct from** the data conveyed by the information symbols. To the contrary, if the information provided by the modulation indices would be distinct from the data conveyed by the information symbols, then it would not be possible to use this information for the purpose of checking the accuracy of the data conveyed by the information symbols, which is exactly the purpose of the method according to Hwang et al.

Furthermore, present claims 1 and 16 require that the receiver evaluates the modulated signal **to obtain** the data conveyed by the information symbols **and the additional information** conveyed by the modulation indices. To the contrary, in the method according to Hwang et al., the receiver does not obtain the additional information from the modulation indices. Instead, in order to be able to use the modulation index for error checking, the receiver must previously "know" what valid modulation indices are associated with what data values at what signaling intervals or time points. For example, the receiver must know that only the modulation indices ha and hb can arise at time i for data values +1 or -1 respectively. The receiver

then uses this "previously known" information in evaluating the received modulated signal. Only thereby is the receiver able to determine whether the data value conveyed by the data symbol "matches" the modulation index.

This feature of Hwang et al. has the effect of increasing the minimum Euclidian distance of a phase trellis of different symbol sequences (pages 1451 and 1452, Figs. 1 and 2). That improves the accuracy (reduces the error rate) in the detection of the data values represented by the data symbols, but does **not** involve (or enable) conveying additional information in addition to **and distinct from** the data conveyed by the information symbols. The respective data value strictly determines the associated modulation index (e.g. +1 is always associated with ha, and -1 is always associated with hb, at time i). There is no additional distinct information, but rather only a redundant transmission of the same data value +1 or -1.

The Examiner seems to be asserting that the modulation index also indicates the data type, namely that the data is bipolar. That is not information conveyed by the modulation index, but rather an *a priori* design parameter of the transmission method. Namely, when a bipolar data symbol is used in the transmission method, then a bipolar modulation index must be used, so that h_{+i} is associated with +1 and h_{-i} is associated with -1 at time i. The modulation index itself does not inform the receiver that a bipolar data type is being used, but rather the receiver must "know" this beforehand in order to be able to receive and evaluate the transmitted signal.

Since Piirainen et al. do not teach the inventive features regarding the modulation indices conveying additional information, as acknowledged by the Examiner, and since Hwang et al. teach away from the inventive features (by requiring a strict correspondence between the modulation index and the associated data symbol's value), even a combined consideration of the two references would not have suggested the invention as now claimed. Namely, even a combination of the references would not have suggested the inventive feature whereby the modulation indices convey additional information in addition to and distinct from the data conveyed by the information symbols, because neither reference gives any suggestions or motivations in this regard.

9) For the above reasons, the Examiner is respectfully requested to withdraw the rejection of claims 1, 3, 5, 16 to 19, 21, 22, 27, 28 and 32 as obvious over Piirainen et al. in view of Hwang et al.

10) Referring to pages 4 to 9 of the Office Action, the further rejections of claims 2, 7, 10, 14, 20, 23 to 26 and 29 to 31 as obvious over Piirainen et al. in view of Hwang et al., and further in view of any one or more of Scott, Fonseka, Beale et al., Ricci et al., Ho et al., the admitted prior art disclosed in the present application, and Landolsi, are respectfully traversed.

All of these rejected claims depend from claim 1 or 16, which have been discussed above in comparison to Piirainen et al. and Hwang et al. The dependent claims are patentable already in

view of their dependence. The additional references do not disclose and would not have suggested the significant features of claims 1 and 16 that have been discussed above.

For example, Fonseka aims to improve the accuracy (reduce the error rate) of the detection of the data symbols in the receiver, and does not give any suggestion toward modulation indices conveying additional information in addition to and distinct from the data conveyed by the information symbols (see abstract and introduction of Fonseka), similarly to the disclosure of Hwang et al. that has been discussed above. Instead, Fonseka discloses varying the modulation index as well as the symbol duration for successive information symbols, whereby the assignment or allocation of the modulation symbol and of the symbol duration are carried out according to pre-specified variation patterns or schemes, without being able to convey any additional information distinct from the data conveyed by the information symbols (see page 1518).

Ho discloses a transmission method involving the insertion of pilot symbols into the sequence of normal information symbols, whereby the pilot symbols are dependent on the input data, and represent extra information symbols that increase the evaluation overhead, rather than involving the provision of additional distinct information in the modulation indices of the normal information symbols. Ho also teaches not to vary the modulation indices.

In comparison to present claim 23, the admitted prior art merely discloses that different types of information exist and that the data type can be represented by the information symbols.

Namely, the admitted prior art always involves encoding the data type using additional information symbols, which necessarily increases the transmission overhead by requiring a longer sequence of information symbols to convey both the data type as well as the data values encoded in the information symbols. That is exactly the disadvantage being overcome by the present invention. According to present claim 23, the modulation index identifies the data type, while the information conveyed by the information symbol gives the numerical value of this data item, for example. Piirainen et al. and Hwang et al. would not have suggested using modulation indices to convey a data type, while the information symbols only convey the data values, for example. On the other hand, the admitted prior art of this application expressly involves conveying the data type through encoding with extra information symbols. Thus, there would have been no suggestion toward conveying a data value in an information symbol while conveying the data type of that data value in the modulation index associated with that information symbol.

For the above reasons, the Examiner is respectfully requested to withdraw the rejections of claims 2, 7, 10, 14, 20, 23 to 26, and 29 to 31.

11) It is submitted that the application should now be in allowable condition. However, if any unresolved issue remains after the Examiner's consideration of this Response, the applicant respectfully requests a telephone interview between the undersigned attorney and the Examiner to address such remaining issue, if any.

12) Favorable reconsideration and allowance of the application, including all present claims 1 to 3, 5, 7, 10, 13, 14 and 16 to 32, are respectfully requested.

Respectfully submitted,
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_____ 1/31/06
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